

**Claims:** we claim:

1. A method for continuous drawing of fibers, comprising the steps of:  
feeding the fiber at an inlet speed to an apparatus for fiber drawing,  
drawing the fiber at a draw speed using the apparatus for fiber drawing,  
conveying the drawn fiber from the fiber drawing apparatus at an outlet  
speed  $V_{\text{outlet}}$ ,  
wherein the fiber drawing apparatus is constructed and arranged to provide a ratio  
of fiber outlet speed  $V_{\text{outlet}}$  to the highest value of a fiber speed in the drawing process  $(V_{\text{fiber}})_{\text{max}}$   
greater than 1 to 1.
2. The method of claim 1 wherein the fiber drawing apparatus is constructed and  
arranged to provide the ratio of outlet speed  $V_{\text{outlet}}$  to the highest value of fiber speed in the  
drawing process  $(V_{\text{fiber}})_{\text{max}}$  greater than about 10 to 1.
3. The method of claim 2 wherein the fiber drawing apparatus is constructed and  
arranged to provide the ratio of outlet speed  $V_{\text{outlet}}$  to the highest value of fiber speed in the  
drawing process  $(V_{\text{fiber}})_{\text{max}}$  greater than about 50 to 1.
4. The method of claim 3 wherein the fiber drawing apparatus is constructed and  
arranged to provide the ratio of outlet speed  $V_{\text{outlet}}$  to the highest value of fiber speed in the  
drawing process  $(V_{\text{fiber}})_{\text{max}}$  greater than about 100 to 1.
5. The method of claim 4 wherein the fiber drawing apparatus is constructed and  
arranged it to provide the ratio of outlet speed  $V_{\text{outlet}}$  to the highest value of fiber speed in the  
drawing process  $(V_{\text{fiber}})_{\text{max}}$  greater than about 500 to 1.
6. The method of claim 5 wherein the fiber drawing apparatus is constructed and  
arranged to provide the ratio of outlet speed  $V_{\text{outlet}}$  to the highest value of fiber speed in the  
drawing process  $(V_{\text{fiber}})_{\text{max}}$  greater than about 1000 to 1.
7. The method of claim 1 wherein the fiber drawing apparatus comprises a conveyer-  
drawing structure having at least two conveyer-drawing means for conveying and simultaneous  
drawing of the fiber,  
wherein the conveyer-drawing means are disposed about a central axis which is  
parallel to a direction of conveying,

wherein the conveyer-drawing means have receiving ends for receiving the fiber and delivery ends for delivering the fiber, and both the receiving ends and the delivery ends are spaced along the central axis,

wherein the delivery ends are spaced further from the central axis than the receiving ends,

wherein the fiber drawing apparatus comprises a means for feeding the fiber to the drawing apparatus and laying the fiber in successive controlled loops around the receiving ends of the conveyer-drawing means,

wherein the conveyer-drawing means draw the fiber at the draw speed by expanding the circumference of the fiber loops while conveying the fiber loops along the central axis from the receiving ends to the delivery ends, a layer comprising the coiled fiber loops being formed about the conveyer-drawing means, and

wherein the fiber drawing apparatus comprises a take-off means for taking off the fiber leading loops continuously from the delivery ends of the conveyer-drawing means and conveying the drawn fiber from the drawing apparatus at outlet speed  $V_{\text{outlet}}$ .

8. The method of claim 7 wherein the fiber feed means further comprises a fiber winding flyer which rotates about the central axis laying the incoming fiber in successive controlled loops around the receiving ends of the conveyer-drawing means.

9. The method of claim 7 wherein the fiber take-off means further comprises a fiber unwinding flyer which rotates about the central axis unwinding the fiber leading loops from the delivery ends of the conveyer-drawing means.

10. The method of claim 7 wherein the conveyer-drawing means are rotating spindles having a fiber displacing member facilitating conveying and simultaneous drawing of the fiber, the displacing member being selected from the group consisting of a thread and a spiral groove.

11. The method of claim 10 wherein the drawing apparatus is constructed and arranged such that the coiled fiber loops are rotated about the central axis by the spindles.

12. The method of claim 7 wherein the conveyer-drawing means are circulating conveyer-drawing members selected from the group consisting of chains, cables, belts, bands, cords, and escalator-type moving stairs.

13. The method of claim 12 wherein the circulating conveyer-drawing members further comprise a plurality of fiber displacing members facilitating conveying and simultaneous drawing of the fibers.

14. The method of claim 13 wherein the displacing members comprise free-to-rotate rollers with circular circumferential grooves,  
 wherein the rollers are constructed and arranged such that their axes are adjusted nearly parallel to the central axis, and  
 wherein the fiber is placed in the grooves of the rollers such that the rollers support the coiled fiber loops.

15. The method of claim 14 wherein the drawing apparatus is constructed and arranged such that the rollers are rotated about their axes, the coiled fiber loops being rotated about the central axis by the rollers.

16. The method of claim 13 wherein the displacing members comprise guide members selected from the group consisting of semi-rings, plates, rods, and pins.

17. The method of claim 7, further comprising a step of adjusting a fiber draw ratio.

18. The method of claim 17, further comprising a means for adjusting the fiber draw ratio, the means being selected from the group consisting of (a) a means for adjusting the distance between the receiving ends and the central axis and (b) a means for changing a position along the central axis where the fiber is received on the conveyer-drawing means.

19. The method of claim 17, further comprising a means for adjusting a fiber draw ratio, the means being selected from the group consisting of (a) a means for adjusting the distance between the delivery ends and the central axis and (b) a means for changing a position along the central axis where the fiber is taken off from the conveyer-drawing means.

20. The method of claim 1, further comprising a step of treatment of the fiber while it being drawn.

21. The method of claim 20, further comprising a means for treatment of the fibers, wherein the means is a heat chamber supplied with a heat medium selected from the group consisting of hot air, hot inert gas, and superheated steam

22. The method of claim 20, further comprising a means for treatment of the fiber selected from the group consisting of hot plate and bath of active media.

23. A method for continuous drawing of fibers, comprising the steps of:  
feeding the fiber at an inlet speed by a feed means to an apparatus for fiber drawing which comprises a conveyer-drawing structure having at least two conveyer-drawing means for conveying and simultaneous drawing of the fiber, wherein the conveyer-drawing means are disposed about a central axis which is parallel to a direction of conveying, wherein the conveyer-drawing means have receiving ends for receiving the fiber and delivery ends for delivering the fiber, and both the receiving ends and the delivery ends are spaced along the central axis, wherein the delivery ends of the conveyer-drawing means are spaced further from the central axis than the receiving ends, and wherein the feed means lays the incoming fiber in successive controlled loops about the receiving ends of the conveyer-drawing means,

drawing the fiber at a draw speed by expanding the circumference of the fiber loops while conveying the fiber loops along the central axis from the receiving ends to the delivery ends by the conveyer-drawing means, a layer comprising the coiled fiber loops being formed about the conveyer-drawing means,

taking off the fiber loops continuously from the delivery ends of the conveyer-drawing means by a take-off means and conveying the drawn fiber by the same means from the fiber drawing apparatus at an outlet speed  $V_{\text{outlet}}$ ,

wherein the fiber drawing apparatus is constructed and arranged to provide a ratio of fiber outlet speed  $V_{\text{outlet}}$  to the highest value of a fiber speed in the drawing process  $(V_{\text{fiber}})_{\text{max}}$  greater than 1 to 1.

24. The method of claim 23 wherein the fiber drawing apparatus is constructed and arranged to provide the ratio of outlet speed  $V_{\text{outlet}}$  to the highest value of fiber speed in the drawing process  $(V_{\text{fiber}})_{\text{max}}$  greater than about 10 to 1.

25. The method of claim 24 wherein the fiber drawing apparatus is constructed and arranged to provide the ratio of outlet speed  $V_{\text{outlet}}$  to the highest value of fiber speed in the drawing process  $(V_{\text{fiber}})_{\text{max}}$  greater than about 50 to 1.

26. The method of claim 25 wherein the fiber drawing apparatus is constructed and arranged to provide the ratio of outlet speed  $V_{\text{outlet}}$  to the highest value of fiber speed in the drawing process  $(V_{\text{fiber}})_{\text{max}}$  greater than about 100 to 1.

27. The method of claim 26 wherein the fiber drawing apparatus is constructed and arranged to provide the ratio of outlet speed  $V_{\text{outlet}}$  to the highest value of fiber speed in the drawing process  $(V_{\text{fiber}})_{\text{max}}$  greater than about 500 to 1.
28. The method of claim 27 wherein the fiber drawing apparatus is constructed and arranged to provide the ratio of outlet speed  $V_{\text{outlet}}$  to the highest value of fiber speed in the drawing process  $(V_{\text{fiber}})_{\text{max}}$  greater than about 1000 to 1.
29. The method of claim 23 wherein the fiber feed means further comprises a fiber winding flyer which rotates about the central axis laying the incoming fiber in successive controlled loops around the receiving ends of the conveyer-drawing means.
30. The method of claim 23 wherein the fiber take-off means further comprises a fiber unwinding flyer which rotates about the central axis unwinding the fiber leading loops from delivery ends of the conveyer-drawing means.
31. The method of claim 23 wherein the conveyer-drawing means are rotating spindles having a fiber displacing member facilitating conveying and simultaneous drawing of the fiber, the displacing member being selected from the group consisting of a thread and a spiral groove.
32. The method of claim 31 wherein the drawing apparatus is constructed and arranged such that the coiled fiber loops are rotated about the central axis by the spindles.
33. The method of claim 23 wherein the conveyer-drawing means are circulating conveyer-drawing members selected from the group consisting of chains, cables, belts, bands, cords, and escalator-type moving stairs.
34. The method of claim 33 wherein the circulating conveyer-drawing members further comprise a plurality of fiber displacing members facilitating conveying and simultaneous drawing of the fibers.
35. The method of claim 34 wherein the displacing members comprise free-to-rotate rollers with circular circumferential grooves,  
wherein the rollers are constructed and arranged such that their axes are adjusted nearly parallel to the central axis, and

wherein the fiber is placed in the grooves of the rollers such that the rollers support the coiled fiber loops.

36. The method of claim 35 wherein the drawing apparatus is constructed and arranged such that the rollers are rotated about their axes, the coiled fiber loops being rotated about the central axis by the rollers.

37. The method of claim 34 wherein the displacing members comprise guide members selected from the group consisting of semi-rings, plates, rods, and pins.

38. The method of claim 23, further comprising a step of adjusting a fiber draw ratio.

39. The method of claim 38, further comprising a means for adjusting the fiber draw ratio, the means being selected from the group consisting of (a) a means for adjusting the distance between the receiving ends and the central axis and (b) a means for changing a position along the central axis where the fiber is received on the conveyer-drawing means.

40. The method of claim 38, further comprising a means for adjusting a fiber draw ratio, the means being selected from the group consisting of (a) a means for adjusting the distance between the delivery ends and the central axis and (b) a means for changing a position along the central axis where the fiber is taken off from the conveyer-drawing means.

41. The method of claim 23, further comprising a step of treatment of the fiber while it being drawn.

42. The method of claim 41, further comprising a means for treatment of the fibers, wherein the means is a heat chamber supplied with a heat medium selected from the group consisting of hot air, hot inert gas, and superheated steam

43. The method of claim 41, further comprising a means for treatment of the fiber selected from the group consisting of hot plate and bath of active media.

44. An apparatus for continuous drawing of fibers, comprising:  
a conveyer-drawing structure having at least two conveyer-drawing means for conveying and simultaneous drawing of the fiber, wherein the conveyer-drawing means are disposed about a central axis which is parallel to a direction of conveying, wherein the conveyer-

drawing means have receiving ends for receiving the fiber and delivery ends for delivering the fiber, and both the receiving ends and the delivery ends are spaced along the central axis, and wherein the delivery ends of the conveyer-drawing means are spaced further from the central axis than the receiving ends,

a means for feeding the fiber at an inlet speed to the conveyer-drawing means and laying the fiber in successive controlled loops about the receiving ends of the conveyer-drawing means,

a means for taking off the fiber loops continuously from the delivery ends of the conveyer-drawing means and conveying the drawn fiber from the fiber drawing apparatus at an outlet speed  $V_{\text{outlet}}$ , and

a means for driving the conveyer-drawing means,

wherein the conveyer-drawing means draw the fiber at a draw speed by expanding the circumference of the fiber loops while conveying the fiber loops along the central axis from the receiving ends to the delivery ends, a layer comprising the coiled fiber loops being formed about the conveyer-drawing means, and

wherein the fiber drawing apparatus is constructed and arranged to provide a ratio of fiber outlet speed  $V_{\text{outlet}}$  to the highest value of a fiber speed in the drawing process  $(V_{\text{fiber}})_{\text{max}}$  greater than 1 to 1.

45. The drawing apparatus of claim 44 wherein the apparatus is constructed and arranged to provide the ratio of outlet speed  $V_{\text{outlet}}$  to the highest value of fiber speed in the drawing process  $(V_{\text{fiber}})_{\text{max}}$  greater than about 10 to 1.

46. The drawing apparatus of claim 45 wherein the fiber drawing apparatus is constructed and arranged to provide the ratio of outlet speed  $V_{\text{outlet}}$  to the highest value of fiber speed in the drawing process  $(V_{\text{fiber}})_{\text{max}}$  greater than about 50 to 1.

47. The drawing apparatus of claim 46 wherein the fiber drawing apparatus is constructed and arranged to provide the ratio of outlet speed  $V_{\text{outlet}}$  to the highest value of fiber speed in the drawing process  $(V_{\text{fiber}})_{\text{max}}$  greater than about 100 to 1.

48. The drawing apparatus of claim 47 wherein the fiber drawing apparatus is constructed and arranged to provide the ratio of outlet speed  $V_{\text{outlet}}$  to the highest value of fiber speed in the drawing process  $(V_{\text{fiber}})_{\text{max}}$  greater than about 500 to 1.

49. The drawing apparatus of claim 48 wherein the fiber drawing apparatus is constructed and arranged to provide the ratio of outlet speed  $V_{\text{outlet}}$  to the highest value of fiber speed in the drawing process  $(V_{\text{fiber}})_{\text{max}}$  greater than about 1000 to 1.

50. The drawing apparatus of claim 44 wherein the fiber feed means further comprises a fiber winding flyer which rotates about the central axis laying the incoming fiber in successive controlled loops around the receiving ends of the conveyer-drawing means.

51. The drawing apparatus of claim 44 wherein the fiber take-off means further comprises a fiber unwinding flyer which rotates about the central axis unwinding the fiber leading loops from delivery ends of the conveyer-drawing means.

52. The drawing apparatus of claim 44 wherein the conveyer-drawing means are rotating spindles having a fiber displacing member facilitating conveying and simultaneous drawing of the fiber, the displacing member being selected from the group consisting of a thread and a spiral groove.

53. The drawing apparatus of claim 52 wherein the apparatus is constructed and arranged such that the coiled fiber loops are rotated about the central axis by the spindles.

54. The drawing apparatus of claim 44 wherein the conveyer-drawing means are circulating conveyer-drawing members selected from the group consisting of chains, cables, belts, bands, cords, and escalator-type moving stairs.

55. The drawing apparatus of claim 54 wherein the circulating conveyer-drawing members further comprise a plurality of fiber displacing members facilitating conveying and simultaneous drawing of the fibers.

56. The drawing apparatus of claim 55 wherein the displacing members comprise free-to-rotate rollers with circular circumferential grooves,

wherein the rollers are constructed and arranged such that their axes are adjusted nearly parallel to the central axis, and

wherein the fiber is placed in the grooves of the rollers such that the rollers support the coiled fiber loops.



57. The drawing apparatus of claim 56 wherein the apparatus is constructed and arranged such that the rollers are rotated about their axes, the coiled fiber loops being rotated about the central axis by the rollers.

58. The drawing apparatus of claim 55 wherein the displacing members comprise guide members selected from the group consisting of semi-rings, plates, rods, and pins.

59. The drawing apparatus of claim 44, further comprising a means for adjusting a fiber draw ratio.

60. The drawing apparatus of claim 59 wherein the means for adjusting the fiber draw ratio is a member selected from the group consisting of (a) a means for adjusting the distance between the receiving ends and the central axis and (b) a means for changing a position along the central axis where the fiber is received on the conveyer-drawing means.

61. The drawing apparatus of claim 59 wherein the means for adjusting the fiber draw ratio is a member selected from the group consisting of (a) a means for adjusting the distance between the delivery ends and the central axis and (b) a means for changing a position along the central axis where the fiber is taken off from the conveyer-drawing means.

62. The drawing apparatus of claim 44, further comprising a means for treatment of the fiber while it being drawn.

63. The drawing apparatus of claim 62 wherein the means for treatment of the fibers is a heat chamber supplied with a heat medium selected from the group consisting of hot air, hot inert gas, and superheated steam

64. The drawing apparatus of claim 62 wherein the means for treatment of the fiber is selected from the group consisting of hot plate and bath of active media.